Measuring the affective state in pigs: the role of immunoglobulin A

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The affective state

• Growing consumers’ wish: products from animal friendly housing (Roex & Miele, 2005)
• Affective state as important part of animal welfare (Vanhonacker et al., 2008)
• Low reliability and high subjectivity of existing measurement methods (Czycholl et al., 2017)

→ Need for objective indicators to measure the animals affective state (Webster, 2005)
Aim of the present study

- Immunoglobulin A (IgA) in human studies
  - Humor arousal increases IgA concentration in human saliva (McClelland & Cheriff, 1997)
  - Reduction of salivary IgA in stress conditions (Afrisham et al., 2016)

- Pigs as an often described animal model for humans
  - Similar oral maxillofacial region (Wang et al., 2007)
  - Porcine immune system resembles humans for >80% (Dawson, 2011)

IgA concentration in saliva = reliable indicator to measure the affective state of pigs?
Animals & housing

- 288 cross breed ((LW x LR) x Pi) fattening pigs
  - 125 male
  - 163 female
- Three different housing systems in Northern Germany
  - Conventional system
  - Straw interspersed indoor and outdoor area
  - Straw interspersed indoor and outdoor area + rooting area
- Two batches (summer, winter)
- Undocked, castrated (males)
Saliva sampling & analysis

- End of final fattening (body weight ~ 100kg)
- Synthetic fiber role (Cortisol-Salivette®, Sarstedt AG & Co, Nümbrecht – Germany)
- Immediate freezing

- Defreezing & centrifugation (1000xg, 20°C, 2 min)
- Direct quantitative sandwich-ELISA-Kit for pig-IgA (Celltrend GmbH, Luckenwalde – Germany)
Statistical analysis

  - Log10-transformation for normal distribution
  - Linear mixed model (PROC MIXED)

\[ y_{ijkl} = \mu + F_i + S_j + B_{ik} + e_{ijkl} \]

\[ y_{ijkl} = \text{l}^{\text{th}} \text{ observation of the log10-IgA concentration (l = 1,\ldots, 288)} \]
\[ \mu = \text{general mean} \]
\[ F_i = \text{fixed effect of the i}^{\text{th}} \text{ farm (i = 1, 2, 3)} \]
\[ S_j = \text{fixed effect of the j}^{\text{th}} \text{ sex (j = 1 (female), 2 (male))} \]
\[ B_{ik} = \text{fixed effect of the k}^{\text{th}} \text{ batch within the i}^{\text{th}} \text{ farm (k = 1, 2)} \]
\[ e_{ijkl} = \text{random residual error} \]

- Significance level: 5%
Effect of sex

### Results

<table>
<thead>
<tr>
<th>Sex</th>
<th>LSM ± SE [µg/ml]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>58.9 ± 1.1</td>
</tr>
<tr>
<td>Male</td>
<td>72.6 ± 1.1</td>
</tr>
</tbody>
</table>

a, b: significant differences between the sexes
Effect of batch within the farm

<table>
<thead>
<tr>
<th>Farm</th>
<th>Batch</th>
<th>LSM±SE [µg/ml]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>43.7 ± 1.1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>53.0 ± 1.1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>132.2 ± 1.1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>86.5 ± 1.1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>37.4 ± 1.3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>79.1 ± 1.2</td>
</tr>
</tbody>
</table>

A, B: significant differences between the batches within the farm
a - c: significant differences between the farms within the batches
IgA = suitable indicator?

- **Effect of sex**
  - Influence of sex hormones (Gaillard & Spinedi, 1998)
    → Estrogen = IgA↑, androgen = IgA↓
    (Grossmann, 1984)
    → Castration (Grossmann, 1984)

- **Effect of batch within the farm**
  - Different environments: barren vs. enriched
    → Affective state (Bosch et al., 2004)
    → Health (Kelley, 1980, Neville, 2008)
    → Interindividual, e.g. genetics
    (Calder & Kew, 2002, Mangino et al., 2017)
Outlook
Thank you for your attention!
References

• Feeding conditions
  – Farm 1
    → 16.5 % (foremast) – 15.5% (final fattening) raw protein
    → Main protein supply: soy extraction meal
  – Farm 2
    → 22.4% (foremast) – 15.4% (final fattening) raw protein
    → Main protein supply: field beans, peas, potato protein
  – Farm 3
    → 20.5% raw protein
    → Main protein supply: field beans